

Quantum Electrical Metrology Division
Electrical and Electronics Engineering Laboratory
Ac-dc Difference Standards and Measurement Techniques Project

Monthly Highlight Submission

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Category: Impact of NIST Research and Services

EEEL Researchers Announce

World's Best 1 Ampere Current Standard

Researchers in the Quantum Electrical Metrology Division of the Electrical and Electronics Engineering Laboratory have recently designed and fabricated the world's best standard for the calibration of ac current at 1 A. The device, a thin-film multijunction thermal converter (MJTC), was designed and modeled in collaboration with Hector Laiz at the Instituto Nacional de Tecnologia Industrial (INTI) in Argentina and fabricated at Sandia National Laboratories. The basic microchip design features a 5 mm x 3.8 mm heater resistor of a copper-gold alloy deposited on a low-stress silicon-nitride film on a silicon wafer. Eighty thermocouples in two banks flank the heater. To make the heater area an isothermal region, deep reactive ion etching is used to etch a moat around the heater from the back. Simulations show that practically all of the heat generated in the heater is sensed by the thermoelements, making the device extremely sensitive. The device is designed to carry 1 A yet the design allows for a small temperature rise in the heater (on the order of 10 K) to reduce temperature dependent errors. Low- and high-frequency errors are also reduced by features of the design. Measurements on the prototype indicate ac-dc difference of less than 3 $\mu\text{A/A}$ over the entire frequency range from 10 Hz to 100 kHz, performance that surpasses all previous 1 A current standards over this frequency range. These devices will permit a significant reduction in the NIST uncertainties for ac current (possibly as much as a factor of 10), as well as lead to improved measurements of ac power.

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